

Mortality from Gastric Cardia and Lower Esophagus Cancer and Occupation

Mary H. Ward, PhD

Mustafa Dosemeci, PhD

Pierluigi Cocco, MD

The incidence of adenocarcinoma of the gastric cardia and esophagus is increasing steadily in the United States. Little is known about the etiology of these cancers. We used occupation and industry information on the death certificates from 24 states (1984 to 1989) to conduct a case-control analysis of gastric cardia and gastric cardia/lower esophagus cancer. Risks were also calculated for other gastric cancers combined. Controls were deaths from other causes except cancer and gastrointestinal disorders. Increased risks of gastric cardia and cardia/lower esophagus among white women were found for administrative jobs (cardia odds ratio (OR) = 3.9; 95% confidence interval (CI), 1.5–9.8) and health professionals (cardia OR = 1.8; 95% CI, 0.6–5.3). Occupations associated with a lower socioeconomic status showed no significant excess risks. A similar pattern in risks was seen for men.

The incidence of adenocarcinoma of the gastric cardia and esophagus rose steadily from 1976 to 1987 in the United States, the United Kingdom, and Denmark.^{1–5} Women experience these tumors less than men (male-to-female incidence ratio is 5.6 among whites and 3.4 among blacks for gastric cardia; 7.6 among whites and 14 among blacks for adenocarcinoma of the esophagus). The average annual increase in incidence rates among white women has been approximately the same as white men for gastric cardia (men 4.3%, women 4.1%) but lower for adenocarcinomas of the esophagus (men 9.4%, women 4.5%).¹ The rising rates for adenocarcinomas of the gastric cardia and esophagus are in contrast to the fairly stable rates of squamous cell carcinoma of the esophagus and steady or slightly decreasing rates of adenocarcinoma of the more distal stomach.

The high male-to-female ratios of these tumors are similar to those seen for squamous cell carcinomas of the esophagus.^{1,3} However, unlike squamous cell cancers of the esophagus, smoking and alcohol do not appear to be strong risk factors.^{6–9} Few studies have evaluated occupational associations and these tumors. Two studies found a predominance of higher social class and professional/skilled occupational groups among men with gastric cardia cancer or adenocarcinoma of the esophagus.^{4,9}

The evaluation of occupational associations may identify groups with higher risk and lend some insight into occupational or lifestyle factors that may play a role in the rising rates of these cancers. Using occupational information on death certificates from 24 states, we evaluated the association of occupation and industry with carcinoma of the cardia, cardia and lower

From the Occupational Studies Section, Environmental Epidemiology Branch, National Cancer Institute, Rockville, Maryland (Dr Ward, Dr Dosemeci), and the Istituto di Medicina del Lavoro, Università di Cagliari, Cagliari, Italy (Dr Cocco).

Address correspondence to: Mary Ward, PhD, National Cancer Institute, 6130 Executive Blvd, MSC 7364, EPN, Room 418, Bethesda, MD 20892-7364.

0096-1736/94/3611-1222\$03.00

Copyright © by American College of Occupational and Environmental Medicine

esophagus combined, and other gastric cancers.

Methods

The coding of occupation and industry titles¹⁰ on death certificates has been supported by the National Cancer Institute, the National Institute for Occupational Safety and Health, and the National Center for Health Statistics since 1984. This data set contains over 2.5 million subjects from 24 states (Colorado, Georgia, Idaho, Indiana, Kansas, Kentucky, Maine, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Utah, Washington, West Virginia, Wisconsin, Vermont). Although coding began in 1984, not all states began coding in that year. This analysis included deaths in these states during the years 1984 through 1989. The three-digit occupation and industry codes were grouped into categories corresponding to Department of Commerce Census code headings. Decedents in a category were compared to all others.

There were a total of 7317 gastric and 3159 esophageal cancer deaths among women for the years 1984–1989. The cancer subsite was listed as gastric cardia for 136 women (whites = 128, blacks = 8) and as lower esophagus for 35 women (whites n = 34, blacks n = 1). Because of the small number of black women with these cancer subsites, the analysis was restricted to whites. Risks were also calculated for white men (gastric cancer deaths 9138, esophagus 7374). Among white men, there were 655 deaths recorded as cardia cancer and 152 as lower esophageal cancer.

Information on cell type is not available in these data; however, over 90% of gastric cardia tumors are adenocarcinomas (unpublished data from the Surveillance, Epidemiology, and End Results (SEER) program). A smaller proportion of lower esophagus tumors are adenocarcinomas (women 23%, men 48%); the remainder are mainly squamous cell carcinomas (unpublished SEER data). For one analysis, cancers of the gastric cardia

and lower esophagus were grouped together because adenocarcinomas of the lower esophagus have been grouped with cardia cancers in some classification schemes. However, because of possible differences in risk factors between squamous cell cancers and adenocarcinomas, carcinomas of the cardia were also analyzed as a separate group. For comparison, the remaining gastric carcinomas excluding cardia (other specified sites and site not otherwise specified (NOS)) were also analyzed.

Five controls per case were randomly selected from deaths from other causes except cancer and gastrointestinal disorders, and were matched to the age (in 5-year groups), gender, and race distribution of the cases. Because of differences in the age distribution between the case groups, separate control groups were used. Using standard logistic regression procedures,¹¹ odds ratios (ORs) were calculated for occupation and industry groups using all other occupations or industries as the referent. Odds ratios were adjusted for age (<49, 50–64, 65–79, 80+).

Results

Decedents with gastric cardia specified as the cancer site represented 2.1% of all gastric cancers among white women (n = 128). Among other gastric cancers, only 21 of 6065 had subsite recorded; the others were listed as NOS. Lower esophagus cancer represented 1.4% of all esophagus cancers among white women (n = 34). Among men, carcinoma of the cardia (n = 655) and lower esophagus (n = 152) accounted for 7.2% and 2.1% of gastric and esophageal cancer deaths, respectively.

The distributions by age and residence for white women and white men with cardia and other gastric cancers (other specified sites/NOS) and their controls are shown in Table 1. The age distributions among gastric cardia and cardia/lower esophagus cases were very similar (data not shown). Gastric cardia cases had a younger age at death compared to other gastric cancer cases, and female cases tended to be slightly older than

men. A greater proportion of gastric cardia cases resided in metropolitan areas compared to other gastric cancer cases.

The age-adjusted ORs for occupation and gastric cardia, cardia/lower esophagus, and other gastric cancers among white women are presented in Table 2. About 50% of women had listed "homemaker" or "retired" as their occupation; there was no association with gastric cardia or cardia/lower esophagus cancer among this group.

Women in administrative/managerial occupations had a significantly elevated risk of gastric cardia and cardia/lower esophagus cancer. The OR increased from 2.8 to 3.9 when cancer of the cardia was evaluated separately. The OR for gastric cardia cancer was also elevated among health professionals (OR = 1.8). In contrast, there was no association for administrative staff occupations.

Elevated associations (OR greater than 1.5) for cardia/lower esophagus cancer were observed among teachers and administrative staff, but the ORs decreased when lower esophageal cancers were excluded. Blue-collar occupations—including cleaners, cooks and waiters, and assemblers and machine operators—were not associated with increased risk for gastric cardia or cardia/lower esophagus cancers. Writers and artists had ORs less than 1 for both gastric cardia and cardia/lower esophagus cancer.

In contrast to the findings for gastric cardia cancer, ORs for other gastric cancers were not elevated among professional occupations. Blue-collar and other occupational groups also showed no association with this gastric cancer group.

The pattern in occupational risks among men was very similar to that for women (Table 3). ORs for gastric cardia were significantly elevated among administrative managers (OR = 1.4) and health professionals (OR = 2.4), while there was no association among administrative staff. Male teachers also had a slightly elevated OR for cardia cancer. Similar risks were observed for cardia/lower esophagus cancer.

Among men, there was no associa-

TABLE 1
Demographic Characteristics of Cases and Controls

	Cardia				Other Gastric*			
	Women (n = 128)		Men (n = 655)		Women (n = 6065)		Men (n = 8483)	
	% of cases	% of controls	% of cases	% of controls	% of cases	% of controls	% of cases	% of controls
Age (years)								
<25	0.8	0.8	0.0	0.0	0.1	0.1	0.0	0.0
25-49	10.1	10.1	10.5	10.5	5.0	5.0	6.9	6.9
50-64	21.8	21.8	40.0	40.0	16.8	16.8	24.0	24.0
65-79	41.4	41.4	42.0	42.0	40.6	40.6	48.6	48.6
80+	25.8	25.8	7.5	7.5	37.4	37.4	20.5	20.5
Residence								
Metropolitan	71.1	60.5	71.3	60.3	65.6	62.3	64.0	59.6
Nonmetropolitan	28.9	39.4	28.7	39.7	34.4	37.7	35.9	40.3
Foreign/unknown	0.0	0.2	0.0	0.1	0.1	0.0	0.1	0.1

* Includes gastric cancer of other sites (not cardia) and gastric cancer (site not otherwise specified).

TABLE 2
Number of Cases and Odds Ratios for Cardia, Cardia/Lower Esophagus, and Other Gastric Cancers Among Occupational Groups of White Women in 24 States

Occupation	Cardia (n = 128)			Cardia/Lower Esophagus (n = 162)			Other Gastric† (n = 6065)		
	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval
Administrative managers	9	3.9	(1.5-9.8)	10	2.8	(1.3-6.3)	168	1.1	(0.9-1.3)
Administrative staff	1	1.2	(0.1-11.0)	2	1.7	(0.3-9.3)	39	1.0	(0.7-1.3)
Health professional	5	1.8	(0.6-5.3)	5	0.9	(0.3-2.4)	160	1.0	(0.8-1.2)
Teacher	5	1.4	(0.5-3.8)	11	1.8	(0.9-3.7)	262	1.1	(0.9-1.2)
Writer, artist	1	0.6	(0.1-5.2)	1	0.7	(0.1-6.4)	32	1.0	(0.7-1.4)
Sales	8	1.3	(0.6-2.9)	9	1.2	(0.5-2.5)	277	1.0	(0.9-1.1)
Administrative support	14	1.4	(0.7-2.6)	16	0.9	(0.5-1.5)	550	1.1	(1.0-1.2)
Cleaner, cook, waiter	8	0.8	(0.3-1.7)	13	1.0	(0.5-1.9)	487	1.0	(0.9-1.2)
Assembler, machine operator	8	0.7	(0.3-1.7)	9	1.1	(0.8-1.6)	384	1.1	(1.0-1.1)
Homemaker, retired	67	1.1	(1.0-1.5)	83	0.8	(0.6-1.2)	3,359	1.1	(0.8-1.1)

* Adjusted for age.

† Includes gastric cancer of other sites (not cardia) and gastric cancer (site not otherwise specified).

tion between blue-collar occupations and gastric cardia or cardia/lower esophagus cancer. In contrast to women, male writers and artists had elevated ORs for cardia (OR = 1.6) and cardia/lower esophagus cancer (OR = 2.2). As was the case for women, no occupational groups were associated with an elevated risk of other gastric cancers.

No significant associations were observed between any industry and cancer of the gastric cardia, cardia/lower esophagus, and other gastric cancers among white women (Table 4). Elevated ORs were observed for both car-

dia and cardia/lower esophagus cancers in the wholesale trade industry. ORs greater than 1.5 for cardia cancer were observed for rubber and chemical manufacturing, utilities and communication, and public administration. In general, the associations for cardia/lower esophagus cancer were not as strong as those for gastric cardia. There was no association between other gastric cancers and any industry.

The associations between industries and gastric cardia cancer among men were very similar to those among women (Table 5). ORs were elevated and some were significant in the fol-

lowing industries: rubber and chemical manufacturing, utilities and communication, professional service, and public administration. One exception was the wholesale trade industry, which was not associated with gastric cardia cancer among men. Similar to the case for women, there was no association between other gastric cancers and any industry group.

Discussion

In our data, the large majority of gastric and esophagus cancers were listed as site NOS on the death certifi-

TABLE 3

Number of Cases and Odds Ratios for Cardia, Cardia/Lower Esophagus, and Other Gastric Cancers Among Occupational Groups of White Men in 24 States

Occupation	Cardia (n = 655)			Cardia/Lower Esophagus (n = 807)			Other Gastric† (n = 8483)		
	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval
Administrative managers	72	1.4	(1.1-1.9)	91	1.5	(1.2-1.9)	785	1.2	(1.1-1.3)
Administrative staff	16	1.2	(0.7-2.1)	19	1.1	(0.7-1.9)	186	1.2	(1.0-1.4)
Health professional	15	2.4	(1.3-4.6)	15	1.8	(1.0-3.2)	93	1.2	(0.9-1.5)
Teacher	13	1.4	(0.8-2.7)	13	1.1	(0.6-2.0)	112	1.0	(0.8-1.3)
Writer, artist	9	1.6	(0.7-3.4)	11	2.2	(1.1-4.6)	68	1.0	(0.7-1.2)
Sales	65	1.1	(0.8-1.5)	82	1.1	(0.8-1.4)	753	1.0	(0.9-1.1)
Administrative support	26	1.2	(0.8-1.9)	34	1.0	(0.7-1.4)	343	1.0	(0.9-1.2)
Cleaner, cook, waiter	44	1.1	(0.8-1.5)	50	1.0	(0.7-1.4)	521	1.0	(0.9-1.1)
Assembler, machine operator	54	0.9	(0.7-1.3)	71	1.0	(0.8-1.3)	766	1.1	(1.0-1.2)
Homemaker, retired	12	0.6	(0.3-1.0)	17	0.5	(0.3-0.9)	182	0.7	(0.6-0.8)

* Adjusted for age.

† Includes gastric cancer of other sites (not cardia) and gastric cancer (site not otherwise specified).

TABLE 4

Number of Cases and Odds Ratios for Cardia, Cardia/Lower Esophagus, and Other Gastric Cancers Among Industry Groups for White Women in 24 States

Occupation	Cardia (n = 128)			Cardia/Lower Esophagus (n = 162)			Other Gastric† (n = 6065)		
	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval
Manufacturing									
Food, textile, paper	6	0.7	(0.3-1.6)	6	0.7	(0.3-1.8)	338	0.7	(0.3-1.6)
Rubber, chemical	3	1.8	(0.5-7.3)	4	1.3	(0.4-4.1)	67	1.0	(0.7-1.3)
Electrical, metal	6	1.2	(0.5-3.2)	8	1.0	(0.5-2.3)	238	1.0	(0.8-1.2)
Utilities, communication	2	1.9	(0.4-10.2)	3	1.3	(0.3-5.1)	56	1.1	(0.9-1.2)
Wholesale trade	3	4.6	(1.0-21.4)	3	3.0	(0.7-12.9)	35	1.0	(0.7-1.4)
Retail trade	14	1.3	(0.7-2.5)	19	1.6	(0.9-2.9)	468	1.0	(0.9-1.1)
Insurance, real estate	2	0.6	(0.1-2.7)	2	0.5	(0.1-2.2)	118	1.1	(1.0-1.2)
Professional service	18	1.4	(0.8-2.5)	26	1.3	(0.8-2.1)	787	1.1	(1.0-1.1)
Service, except repair	4	0.6	(0.2-1.8)	5	0.6	(0.2-1.5)	306	1.0	(0.9-1.2)
Public administration	4	2.2	(0.6-8.1)	4	1.0	(0.3-3.0)	143	1.2	(1.0-1.4)

* Adjusted for age.

† Includes gastric cancer of other sites (not cardia) and gastric cancer (site not otherwise specified).

icates (gastric cancer: women 97.6%, men 92.5%; esophagus: women 98.0%, men 97.3%). Incidence data from the SEER program indicate that 11.5% of gastric cancers among white women and 28.7% among men occurred in the cardia; proportions in our data were 2.1% for women and 7.2% for men. Adenocarcinomas of the esophagus (primarily located in the lower esophagus) were 11.0% of all esophagus cancers among women and 26.3% among men in the SEER data¹ compared to 1.4% and 2.1% in our data. Five-year relative survival

rates for gastric cardia cancer and adenocarcinomas of the esophagus are very low and comparable to the respective rates for the stomach and esophagus (1976-1987 unpublished SEER data). Therefore, survival differences would not account for the small proportion of death certificates with these subsites.

There is clearly a large degree of underreporting of the subsites of gastric cardia and lower esophagus on death certificates. A study that compared death certificates and hospital diagnoses found that physicians tend

to report a nonspecific site of cancer on the death certificate when a more specific site is known.¹² However, it is not known whether certain individuals are more likely than others to have the subsite recorded. It is possible that a higher level of medical attention, which is related to high socioeconomic status (SES), may result in a greater proportion of high SES decedents with subsite recorded. In these data, the proportion of high SES occupations (administrative managers and professionals) among decedents with other gastric cancer subsites was

TABLE 5
Number of Cases and Odds Ratios for Cardia, Cardia/Lower Esophagus, and Other Gastric Cancers Among Industry Groups for White Men in 24 States

Occupation	Cardia (n = 655)			Cardia/Lower Esophagus (n = 807)			Other Gastric† (n = 8483)		
	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval	Number	Odds Ratio*	Confidence Interval
Manufacturing									
Food, textile, paper	55	1.0	(0.7-1.3)	68	1.0	(0.8-1.3)	756	1.0	(0.9-1.1)
Rubber, chemical	37	1.6	(1.1-2.4)	41	1.6	(1.1-2.3)	322	1.1	(1.0-1.3)
Electrical, metal	111	1.2	(0.9-1.4)	135	1.1	(0.9-1.4)	1345	1.1	(1.0-1.2)
Utilities, communication	23	1.4	(0.9-2.3)	30	1.2	(0.8-5.8)	242	1.2	(1.0-1.3)
Wholesale trade	19	1.0	(0.6-1.6)	27	1.1	(0.7-1.7)	248	1.0	(0.8-1.1)
Retail trade	69	1.2	(0.9-1.6)	77	1.0	(0.7-1.2)	739	1.0	(0.9-1.1)
Insurance, real estate	22	1.3	(0.8-2.0)	29	1.7	(1.1-2.6)	247	1.1	(1.0-1.3)
Professional service	60	1.5	(1.1-2.0)	70	1.3	(1.0-1.7)	559	1.0	(0.9-1.1)
Service, except repair	23	0.9	(0.5-1.3)	30	1.2	(0.8-1.7)	311	1.0	(0.9-1.1)
Public administration	43	1.5	(1.1-2.2)	50	1.1	(0.8-1.5)	402	1.0	(0.9-1.1)

* Adjusted for age.

† Includes gastric cancer of other sites (not cardia) and gastric cancer (site not otherwise specified).

lower than that for cardia cancer (women: cardia 10.9%, other specified sites 4.8%; men: cardia 17.3%, other specified sites 3.8%). If the risk was similar for all subsites, these proportions would also be similar unless preferential recording of subsite by SES occurred only for the gastric cardia. This seems unlikely.

In this study, increased risks of gastric cardia cancer occurred mainly among professional occupations. Also, the associations with industry were mainly found with industries where white-collar jobs predominated (professional service and public administration). Exceptions were elevated ORs in the rubber and chemical industry. Most of the exposed cases were employed in the chemical industry; the diversity of industries in this group makes interpretation of this finding difficult.

Professional occupations are characterized by high income and education levels and high SES. A study in Britain found a greater proportion of men with high SES occupations among cardia/lower esophagus cancer cases compared to the distal stomach.⁴ In the United States, men in professional or skilled occupations represented a greater proportion of cases of adenocarcinoma of the gastric cardia or esophagus compared to distal stomach cancer cases and controls. No differences were seen among women, al-

though the number of cases was small.⁹ Another case-control study found a slightly lower risk of gastric cardia cancer among men with no high school education compared to men who had gone to college. In contrast, risks for low educational level were significantly elevated for other gastric cancer sites.⁸

Little is known about specific risk factors for gastric cardia or lower esophagus cancer. A case-control study in Italy found similar risk factors for gastric cardia and other gastric tumors, including a family history of gastric cancer, low vitamin C intake, and high animal protein intake. Smoking and alcohol have not been consistently associated with risk of these cancers.^{6,7} However, two case-control studies in the United States reported increased risks for smoking and high consumption of alcohol among men^{8,9} and women.⁹ Smoking is less frequent in professional jobs in the United States¹³ and is unlikely to explain the risks for professional occupations.

Gastric cancer is more common among lower SES groups, as indicated by income, education, and occupation.¹⁴ However, we did not observe any associations between high or low SES occupations and other gastric cancers. This group of cancers probably contained a substantial number of cardia tumors, as indicated by the

SEER data; this may have contributed to the dilution of risk for lower SES occupations.

Our analysis of occupation and industry and mortality from gastric cardia and cardia/lower esophagus cancer has several limitations. Most notably, the number of deaths from these subsites as indicated from death certificates represents an undeterminable but probably small fraction of the deaths from these cancers. It is not known whether the recording of gastric cardia cancer on death certificates is selective by occupation or other factors associated with occupation. Another limitation of this type of study is that occupation and industry on death certificates may not accurately reflect a person's usual job or industry.¹⁵ However, this problem is reduced for broad occupational groups, such as those in this study.

In summary, our results for gastric cardia cancer are similar to several studies with incidence data and indicate that lifestyle or other factors related to professional occupations and upper SES may be important in the etiology of these tumors. Further evaluation of occupation and industry may identify high-risk groups and give clues to risk factors for these cancers.

References

1. Blot WJ, Devesa SS, Kneller RW, Fraumeni JF. Rising incidence of adenocar-

- cinoma of the esophagus and gastric cardia. *JAMA*. 1991;265:1287-1289.
2. Yang PC, Davis S. Epidemiological characteristics of adenocarcinoma of the gastric cardia and distal stomach in the United States, 1973-1982. *Int J Epidemiol*. 1988;17:293-297.
3. Yang PC, Davis S. Incidence of cancer of the esophagus in the US by histologic type. *Cancer*. 1989;61:612-617.
4. Powell J, McConkey CC. Increasing incidence of adenocarcinoma of the gastric cardia and adjacent sites. *Cancer*. 1990;62:440-443.
5. Moller H. Incidence of cancer of oesophagus, cardia, and stomach in Denmark. *Eur J Cancer Prev*. 1992;1:159-164.
6. Palli D, Bianchi S, Decarli A, et al. A case-control study of cancers of the gastric cardia in Italy. *Br J Cancer*. 1992;65:263-266.
7. Li J-Y, Ershow AG, Chen Z-J, et al. A case-control study of cancer of the esophagus and gastric cardia in Linxian. *Int J Cancer*. 1989;43:755-761.
8. Wu-Williams A, Yu MC, Mack TM. Life-style, workplace, and stomach cancer by subsite in young men of Los Angeles County. *Cancer Res*. 1990;50:2569-2576.
9. Kabat GC, Ng SKC, Wynder EL. Tobacco, alcohol intake, and diet in relation to adenocarcinoma of the esophagus and gastric cardia. *Cancer Causes Control*. 1993;4:123-132.
10. US Department of Commerce. 1980 *Census of the Population. Alphabetical Index of Industries and Occupations*. Publication no. PHC 80-R3. Washington, DC: US Government Printing Office; 1982.
11. Preston DL, Lubin JH. EPICURE: Programs for the analysis of epidemiologic data, Version 1.8. Seattle: HiroSoft International; 1992.
12. Percy C, Stanek E, Gloeckler L. Accuracy of death certificates and its effect on cancer mortality statistics. *Am J Public Health*. 1981;71:242-250.
13. Covey LS, Zang EA, Wynder EL. Cigarette smoking and occupational status: 1977-1990. *Am J Public Health*. 1992;82:1230-1234.
14. Howson CP, Hiyama T, Wynder E. The decline in gastric cancer: epidemiology of an unplanned triumph. *Epidemiol Rev*. 1986;8:1-27.
15. Schade WJ, Swanson GM. Comparison of death certificate occupation and industry data with lifetime occupational histories obtained by interview: variations in the accuracy of death certificate entries. *Am J Ind Med*. 1988;14:121-136.